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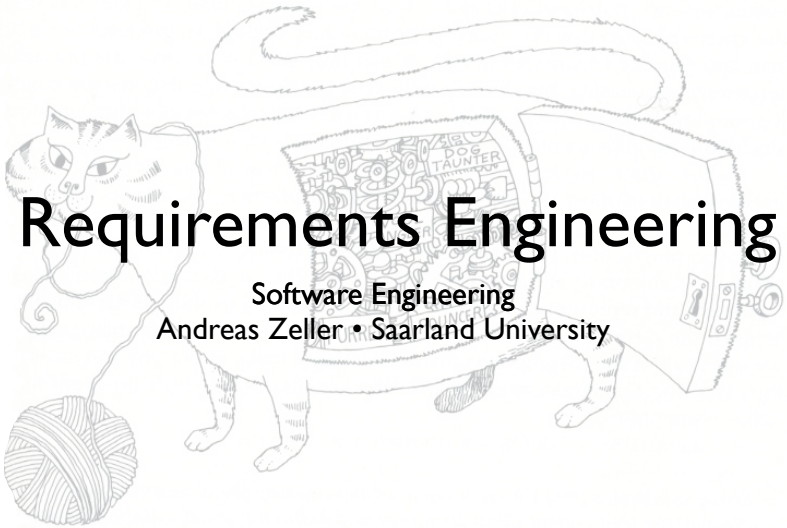
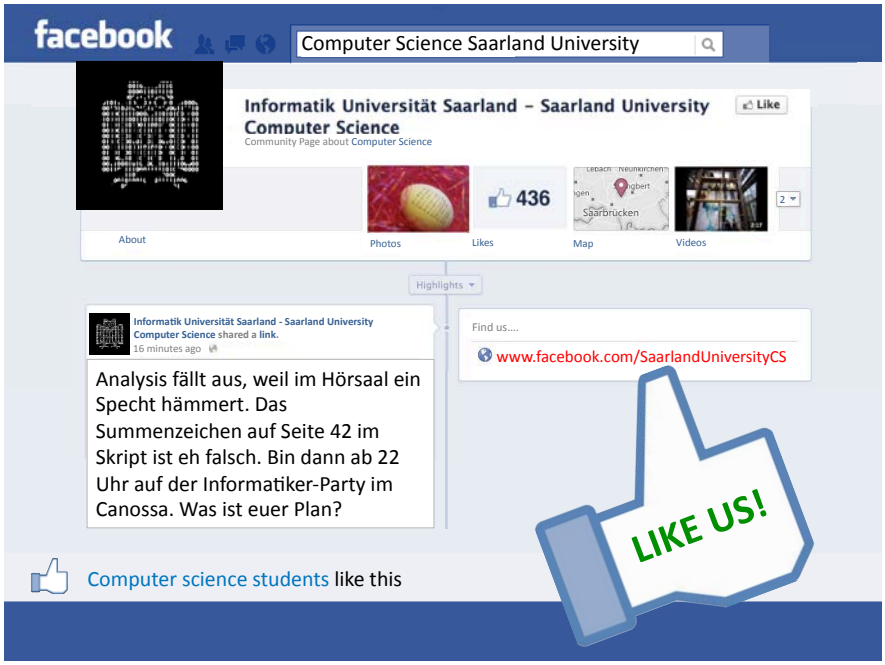
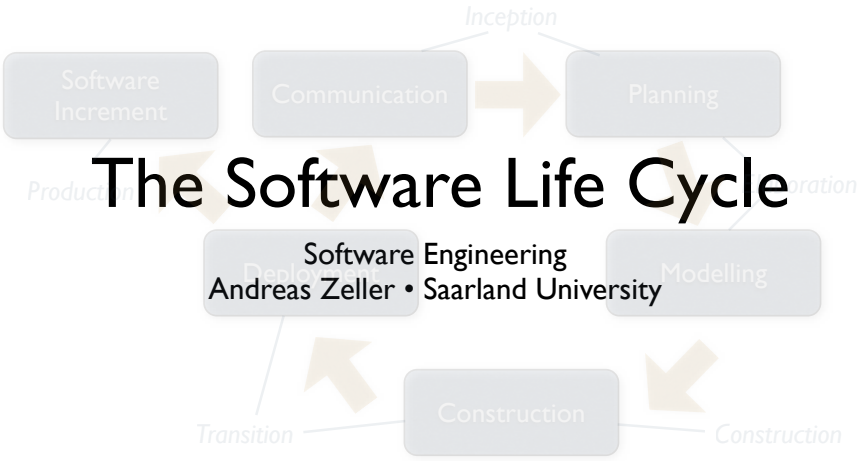


Requirements Engineering

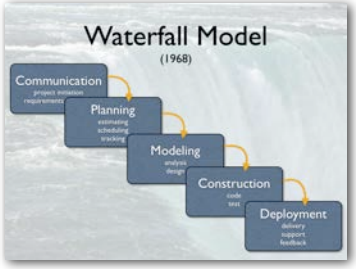
Software Engineering
Andreas Zeller • Saarland University



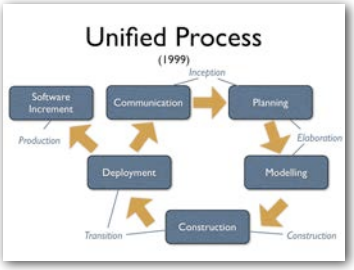


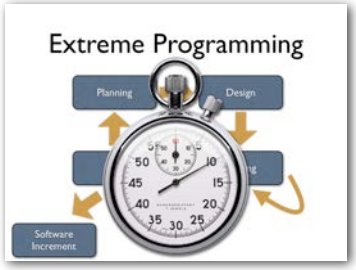
The Software Life Cycle

Software Engineering
Andreas Zeller • Saarland University



Summary





Scrum

Scrum = iterative and incremental agile software development method for managing software projects and product or application development. In rugby, a scrum refers to the manner of restarting the game after a minor infraction.

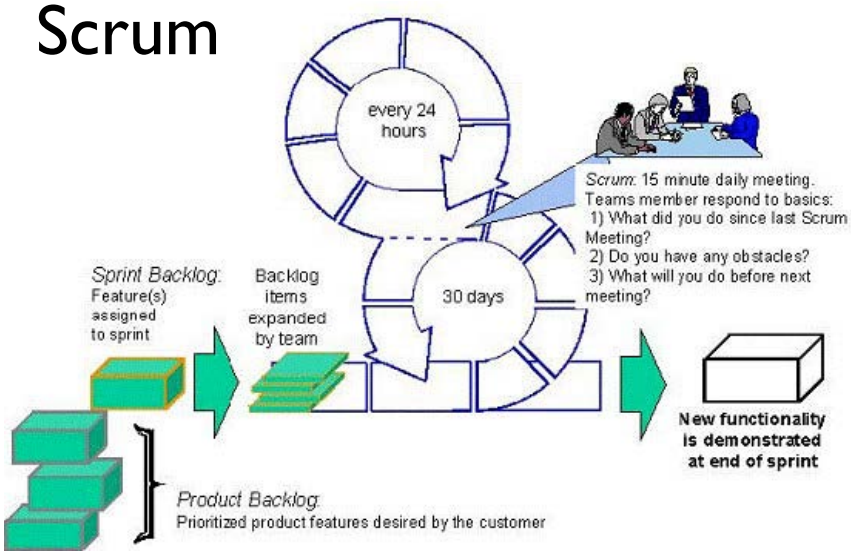
Scrum

- An iterative and incremental agile software development method for managing software projects and product or application development.
- Small working teams to maximize communication, minimize overhead and maximize knowledge sharing.
- Adaptable to technical and business changes.
- Yields frequent software increments that can be inspected.

Scrum

- Development work and the people who perform it are partitioned into clean, low coupling partitions.
- Constant testing and documentation is performed.
- Ability to declare project "done" whenever required.

Scrum



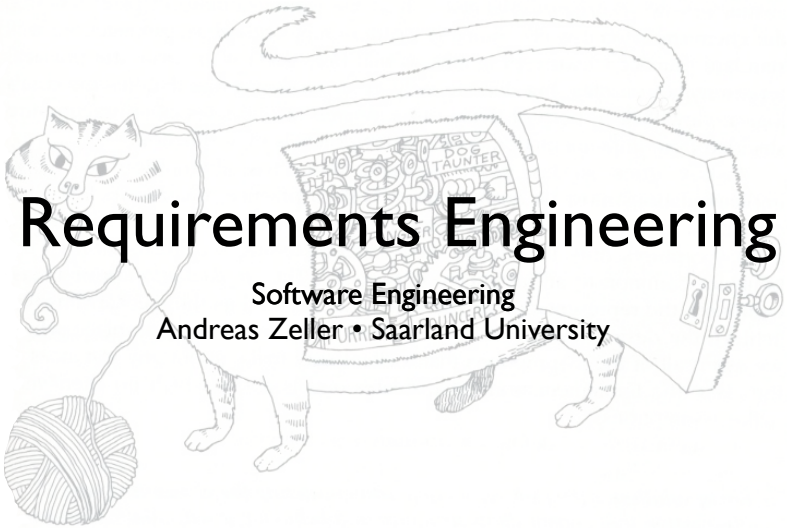
Scrum

Backlog: A prioritised list project requirements or features that provide business value.

Sprints: Consists of work units that are required to achieve a defined backlog into a predefined time-box (usually 30 days).

Scrum Meetings: Short 15 mins. meetings held daily by the scrum team. The Scrum master leads the meeting.

Demos: Demonstrate software increment to the customer for evaluation.



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Waterfall Model

(1968)

- **Communication**
  project initiation
  requirements
- **Planning**
  estimating
  scheduling
  tracking
- **Modeling**
  analysis
  design
- **Construction**
  code
  test
- **Deployment**
  delivery
  support
  feedback

Communication

Communication
project initiation
requirements gathering

6.6 Map Series Tool

Use Case Description	
Summary	User generates one or more maps from a series of maps for a given boundary feature (compartment, landscape etc).
Actors	EIMS User
Pre-Conditions	User requires one or more maps sheets from a series, for a boundary feature.
Post-Conditions	Map or series of maps is generated and printed.
Priority	Required

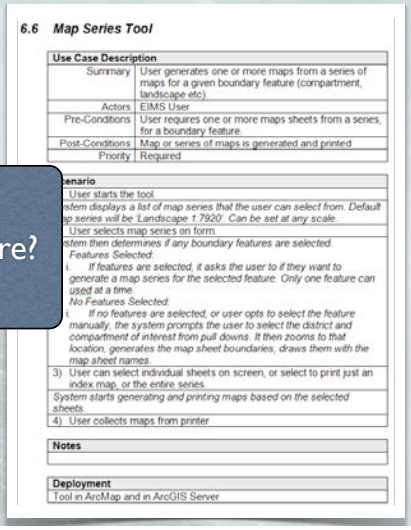
Scenario
1) User starts the tool.
System displays a list of map series that the user can select from. Default map series will be 'Landscape 1:7920'. Can be set at any scale.
2) User selects map series on form.
System then determines if any boundary features are selected. *A. Features Selected:* *i. If features are selected, it asks the user to if they want to generate a map series for the selected feature. Only one feature can used at a time.* *B. No Features Selected:* *i. If no features are selected, or user opts to select the feature manually, the system prompts the user to select the district and compartment of interest from pull downs. It then zooms to that location, generates the map sheet boundaries, draws them with the map sheet names.*
3) User can select individual sheets on screen, or select to print just an index map, or the entire series.
System starts generating and printing maps based on the selected sheets.
4) User collects maps from printer.

Notes

Deployment
Tool in ArcMap and in ArcGIS Server

Communication

How do we get there?



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Notes

Deployment
Tool in ArcMap and in ArcGIS Server

"Requirement"

Standard Glossary of Software Engineering Terminology
(ANSI/IEEE Standard 610.12-1990)

1. A condition or capability needed by a user to solve a problem or achieve an objective.
2. A condition or capability that must be met or possessed by a system or system component to satisfy a contract, standard, specification, or other formally imposed documents.
3. A documented representation of a condition or capability as in (1) or (2).

A Software Crisis

Denver International Airport (DIA)

Construction started in 1989 • 53 sq miles • Planned: 1.7 bio USD costs, opening 1993

Glass' Law

Requirement deficiencies are the prime source of project failures.

This and other laws are found in Endres/Rombach: Handbook of Software and Systems Engineering. Evidence: Denver airport case study and two more

"Requirements Analysis"

Standard Glossary of Software Engineering Terminology
(ANSI/IEEE Standard 610.12-1990)

- The process of studying user needs to arrive at a definition of system, hardware, or software requirements.
- The process of studying and refining system, hardware, or software requirements.

Analysis vs Design

- Analysis = *what* the software should do
  - Software functionality
  - Software properties
- Design = *how* it should do it

Up-front RE

- "We must know [exactly] what to build *before* we can build it"
- classical engineering viewpoint
- leads to waterfall process
- … *but is this realistic for today's systems?*

In our Course

- Gather *Requirements* with few (≤ 3) iterations
- Gather *UI Design* with several (≥ 3) iterations

Topics in Requirements Analysis

- Identify Stakeholders
- Elicit Requirements
- Identify Requirements
- Prototypes

Stakeholders

- Persons or organizations who…
  - have a valid interest in the system
  - are affected by the system

Stakeholders

- anyone who *operates* the system
  (normal and maintenance operators)
- anyone who *benefits* from the system
  (functional, political, financial and social beneficiaries)
- anyone involved in *purchasing* or procuring the system

Stakeholders

- organizations which *regulate* aspects of the system
  (financial, safety, and other regulators)
- organizations responsible for systems which *interface* with the system under design
- people or organizations *opposed* to the system
  (*negative* stakeholders)

Elicit Requirements

- *Interviews* are the best way to elicit requirements
- Explore requirements systematically
- Sounds simple – but is the hardest part!

Why is Elicitation hard?

- Problems of *scope*
  What is the boundary of the system? • What details are actually required?
- Problems of *understanding*
  Users do not know what they want • don't know what is needed • have a poor understanding of their computing environment • don't have a full understanding of their domain • omit "obvious" stuff • are ambiguous
- Problems of *volatility*
  Requirements change over time

Identify Requirements

- Types of requirements
  Functional requirements • Nonfunctional requirements • Constraints
- Contract-style requirements
- Use cases (user stories)

Types of Requirements

Suppose we want to set up a system that tracks who has had how much coffee

Functional Requirements

- An *action* the product must take to be useful

> The product shall allow to track individual payments of coffee servings

Nonfunctional Requirements

- A *property* or *quality* the product must have

> The product shall be accessible in multiple languages
> (such as German and English)

Constraints

- *Global* requirements – on the project or the product

The product shall be available before March 1st.

Contract Style

Requirement	Comment
The system will support client inquiries from four access points: in person, paper-based mail, voice communication, and electronic communication (Internet, dial-up, and LAN/WAN).	Four access points are how; we should focus instead on who needs access from where.
The telephone system must be able to support an 800 number system.	An 800 number? Can't use 888 or 877? Again, what's missing is who needs what kind of access from where.
The telephone system must be able to handle 97,000 calls per year and must allow for a growth rate of 15 percent annually. Of these calls it is estimated that 19 percent will be responded to in an automated manner and 81 percent will be routed to call center staff for response. Fifty percent of the calls can be processed without reference to the electronic copy of the paper file, and approximately 50 percent will require access to the system files.	Valuable statistics; this one is actually pretty good.

From "Use cases: requirements in context" By Daryl Kulak, Eamonn Guiney

Contract Style

Classify product features as

- *Must-have* features
  "The product must conform to accessibility guidelines"
- *May-have* features
  "The product may eventually be voice-controlled"
- *Must-not-have* features
  "The product supports only one language"

Be explicit about *must-not-have* features!

Contract Style

- Provide a *contract* between sponsors and developers
- Can run to *hundreds of pages*
- Abstract all requirements, with little context

Strengths

- Provides a checklist of requirements.
- Provide a contract between the project sponsor(s) and developers.
- For a large system can provide a high level description.

Weaknesses

- Such lists can run to hundreds of pages. It is virtually impossible to read

Contract Style

love it

hate it

Use Case

- An *actor* is something that can act – a person, a system, or an organization
- A *scenario* is a specific sequence of *actions* and *interactions* between actors (where at least one actor is a system)
- A *use case* is a collection of related scenarios – successful and failing ones
- Useful for *clients* as well as for *developers*

Actors and Goals

- What are the *boundaries* of the system? Is it the software, hardware and software, also the user, or a whole organization?
- Who are the *primary actors* – i.e., the stakeholders?
- What are the *goals* of these actors?
- Describe how the system fulfills these goals (including all exceptions)

Example: SafeHome

Initial Scenario

Use case: *display camera views*
Actor: *homeowner*

If I'm at a remote location, I can use any PC with appropriate browser software to log on to the SafeHome Web site. I enter my user ID and two levels of passwords and, once I'm validated, I have access to all the functionality. To access a specific camera view, I select "surveillance" and then "select a camera". Alternatively, I can look at thumbnail snapshots from all cameras by selecting "all cameras". Once I choose a camera, I select "view"…

Refined Scenario

Use case: *display camera views*
Actor: *homeowner*

1. *The homeowner logs on to the Web Site*
2. *The homeowner enters his/her user ID*
3. *The homeowner enters two passwords*
4. *The system displays all major function buttons*
5. *The homeowner selects "surveillance" button*
6. *The homeowner selects "Pick a camera"…*

Alternative Interactions

- Can the actor take some other action at this point?
- Is it possible that the actor encounters some error condition? If so, which one?
- Is it possible that some other behavior is encountered? If so, which one?

Exploring alternatives is the key to successful requirements analysis!

SafeHome

Use-Case Template for Surveillance

Use-case: Access camera surveillance—display camera views (ACS-DCV).
Primary actor: Homeowner.
Goal in context: To view output of camera placed throughout the house from any remote location via the Internet.
Preconditions: System must be fully configured; appropriate user ID and passwords must be obtained.
Trigger: The homeowner decides to take a look inside the house while away.

Scenario:

1. The homeowner logs onto the *SafeHome Products* Web site.
2. The homeowner enters his or her user ID.
3. The homeowner enters two passwords (each at least eight characters in length).
4. The system displays all major function buttons.
5. The homeowner selects "surveillance" from the major function buttons.
6. The homeowner selects "pick a camera."
7. The system displays the floor plan of the house.
8. The homeowner selects a camera icon from the floor plan.
9. The homeowner selects the "view" button.
10. The system displays a viewing window that is identified by the camera ID.
11. The system displays video output within the viewing window at one frame per second.

Exceptions:

1. ID or passwords are incorrect or not recognized—see use-case: "validate ID and passwords."
2. Surveillance function not configured for this system—system displays appropriate error message; see use-case: "configure surveillance function."
3. Homeowner selects "view thumbnail snapshots for all cameras"—see use-case: "view thumbnail snapshots for all cameras."
4. A floor plan is not available or has not been configured—display appropriate error message and see use-case: "configure floor plan."
5. An alarm condition is encountered—see use-case: "alarm condition encountered."

Priority: Moderate priority, to be implemented after basic functions.
When available: Third increment.
Frequency of use: Infrequent.

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Suppose we want to set up a system that tracks who has had how much coffee

What we expect

1. A set of *requirements*
   contract style • ≤4 pages
2. A set of *use cases*
   Pressman style • ~10–20 pages
3. A GUI design
   covering *all* "must-have" and *most* "may-have" use cases
4. Architectural models and data models
   covering *all* "must-have" and *most* "may-have" use cases
5. An executable *prototype*
   covering all "must-have" use cases

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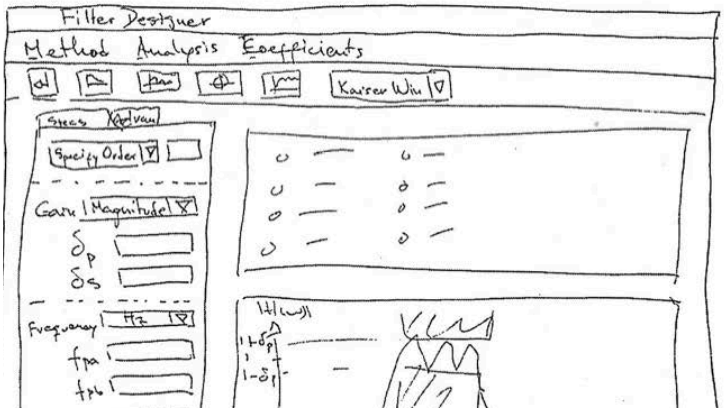

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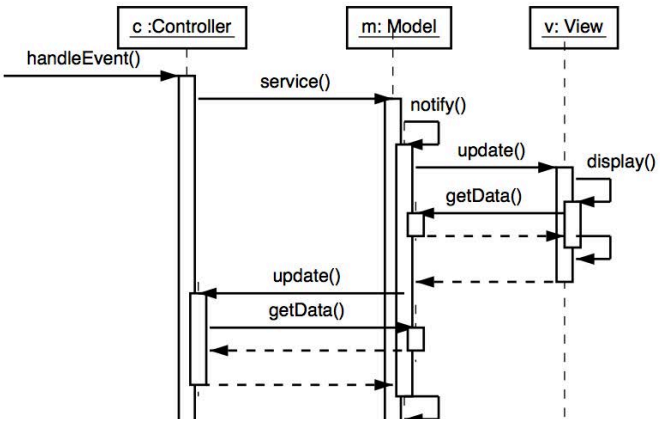

What we expect

5. An executable *prototype*
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What we expect

And then, of course – it's done!

☺

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